Fire Program Analysis – Preparedness Module
Limitations, Constraints, and Restrictions

Date: **May 20, 2005**

Topic: Limitations, Constraints, and Restrictions

Issue: Define the purpose and describe the functionality of limitations, constraints, and restrictions in FPA-PM.

Background/Purpose:
Three functions have been developed and are included in the FPA-PM system to prevent the analysis from using fire resources inappropriately. The three functions are; Fire Resource Limitation, Land Management Constraint, and Fire Management Unit (FMU) Restriction.

Each of the three functions has a specific purpose that must be thoroughly understood by the fire planner. One of the functions is automated with no user input required (Fire Resource Limitation). The remaining two functions require input by the user.

Table 1: Summary of Functions

Function:	Based On	Apply To	System Setting in Lookup Data	User Selected from System Choices	User Defined and Applied
Fire Resource Limitation	Fire Resource Capabilities	All fire events in FPU	**X**		
Land Management Constraint	Law/Policy/ Planning Direction that constrains the type of fire resources that can respond to an FMU	All fire events in FMU for selected time period		**X**	
FMU Restriction	Physical Feature of an FMU that restricts the response one or more types of fire resources	A user defined percent of fire events for each FMU			**X**

Fire Resource Limitation

Definition:
Objective, quantifiable, and broadly accepted limits on the operational capability of various fire resources.

Examples:
- aviation resources are limited to use during daylight hours

- some helicopter types have performance limitations which effectively limit their use above certain elevations.
- dozers should not operate on slopes exceeding 55% per Fireline Handbook standards (410-1).

Data Source:
Most system data is derived from the Fireline Handbook (NWCG Publication 410-1). Some data derived from 410-1 was adjusted for use in the FPA system. Example – some data in 410-1 is in the form of ranges (e.g. 300-500 gallons) where the FPA system required a single value. Decisions were made in consultation with subject matter experts whether to use the mean of the range, the high or low value given, or some other reasonable adjustment. Where no NWCG standard existed, that system data came from national subject matter experts or authoritative documents (e.g. elevation capabilities of various helicopters) and those are described in separate FPA white papers.

User Tasks:
The user does not need to enter any data for this function; however they need to understand how this function affects the analysis to be able to interpret output of the analysis.

System Implication:
The FPA system will need to know certain information about the landscape characteristics of each ignition (elevation, slope) and time of day relative to sunrise/sunset. Information regarding the fire event comes to the FPA system via the fire event scenario developed through the historic analysis.

The system also has to know various operational limits of fire resources by kind/category/type, NFDRS slope class, or time of day. The system then applies operational limits as a filter on the various types of fire resources that can be deployed to each ignition.

Table 2. Operational Limitation Rules in FPA-PM System

Resource – Kind/Category/Type	Limitation	Condition	Comments
Dozers (all types)	Slope percent by fuel model for each fire	Slope must be less than 56%, otherwise no dozers will be deployed to that ignition	Production rates vary by fuel model and slope percent up to the allowable slope limit. Obtain fuel model and slope from fire event data. The system will need to match the fuel and slope of the fire with applicable production rate. Assumptions: - Uphill line construction - Use midpoint of NWCG production rate range by surface fuel model (per fireline handbook (PMS-410-1).
Tractor Plow (all C/T)	Slope percent by fuel model for each fire	Slope must be less than 41% for all fuel models	Production varies by surface fuel model per NWCG fireline handbook (PMS-410-1). Production rates for FBPS models 11-13 are zero. Slope is an upper limit for use of tractor plow. Assumptions: - Tractor plows will be used only on NFDRS slope class 1 & 2 - Use uphill construction production rates only - Production rates for each fuel model are assumed to be the same at all slopes up to the maximum allowable.

Resource – Kind/Category/Type	Limitation	Condition	Comments
Aircraft (all types)	Daylight hours only as defined by civil sunrise/sunset	Daylight hours only	Civil sunset limit to daylight hours to be calculated by system using workload point (lat/long) of the FMU.
Rotor Wing Aircraft (category) by aircraft make and model	Maximum elevation	Elevation by fire event	Different make and model aircraft of the same K/C/T have different elevational capabilities. Costs differ significantly by make and model. IHOG is in the process of defining the capabilities and categories. Need to include placeholder in system for now. Data provided in separate FPA white paper.

Land Management Constraint

Definition:
Prohibition on the use of particular fire resources on all ignitions in a fire management unit. Constraints are derived from direction provided in policy, law, and/or local land management plans. Constraints may apply only during particular sensitivity periods (times of year).

Examples:
- no use of motorized equipment in wilderness
- no use of aerial retardant over sensitive watersheds
- no use of dozers in sensitive archeological areas
- no use of helicopters from April 1 - June 30 to minimize disturbance to nesting sites

Data Source:
The system development team incorporated a limited number of common constraint choices into the lookup data. Additional constraints may be suggested to the development team for inclusion in the lookup data. Users can view a complete list of fire resources that are included in each constraint through the lookup tables found under the system's Admin tab.

User Tasks:
- For each FMU, the user will select applicable constraints from the system's pick list. It is not required for each FMU to have constraints defined. This is a user choice.
- For each constraint selected, the user will define the sensitivity period(s) to which the constraints apply. Constraints may apply to a single two week period, may apply to the entire year, or apply to any combination of two week periods. This is a user choice.
- For each constraint, the user must enter comments in the "Rationale" field in the system to justify the use of the constraint. The rationale should reference land management direction, policy, law, or similar documentation that requires the constraint be in place.
- The constraint selected will then apply to all ignitions in the FMU for the duration of the specified sensitivity period(s).
- If non-concurrent time periods are desired (e.g. spring and fall) or the desired time period bridges the calendar year (e.g. December - January), separate constraints must be defined by the user. This would be accomplished by selecting the constraint, then specifying the contiguous blocks of time for each desired time period.

System Implication:
The FPA system needs to know the FMU constraint to be applied, the FMU to which it will be applied, and the sensitivity period(s) during which it applies. The system will then apply the constraint as a filter on the Kind/Category/Type of equipment deployed to fire events in the FMU during the specified time period.

Table 3. Constraint Pick-List and Definitions in FPA-PM

Constraint	Applies to	FMU Application	Resource Prohibited– Kind/Category/Type
No mechanical equipment	All mechanized equipment	All ignitions within selected sensitivity periods	- Selected per FMU and sensitivity period by fire planner. - Most Restrictive. - Excludes dozers, engines, engine crews, tractor plows, water tenders, all terrain vehicles, and most nonstandard resources including all boats. - Allows handcrews - Allows aviation resources such as helitack *(Note – Considers only self-propelled equipment, does not consider with other types of mechanized equipment such as chainsaws and portable pumps)*
No ground vehicles	All vehicles	All ignitions within selected sensitivity periods	- Selected per FMU and sensitivity period by fire planner. - Excludes all dozers, engines, engine crews, tractor plows, water tenders, all terrain vehicles, other most nonstandard fire resources. - Allows all boats, including airboats. - Allows handcrews - Allows aviation resources such as helitack
No Tractor Plows	All plows (all categories/types)	All ignitions within selected sensitivity periods	- Selected per FMU and sensitivity period by fire planner - Excludes tractor plows of any type, including Flextrack
No dozers or plows	All dozers and plows (all categories/types)	All ignitions within selected sensitivity periods	- Selected per FMU and sensitivity period by fire planner - Excludes dozers, tractor plows, and nonstandard dozer/plow resources as a fire fighting resource. - Allows Airboats.
No rotor wing aircraft	All rotor wing aircraft (all categories/types)	All ignitions within selected sensitivity periods	- Selected per FMU and sensitivity period by fire planner - Excludes rotor wing of any type including helitack and rotor wing retardant drops
No fixed wing air tanker	All fixed wing air tankers (all categories/types)	All ignitions within selected sensitivity periods	- Selected per FMU and sensitivity period by fire planner -Excludes fixed wing air tankers of any type

FMU Restriction

Definition:
A prohibition on the use of certain fire resources on a percentage of ignitions within an FMU based on a physical property of the FMU.

Examples:

- In the Mesa FMU, the land management plan doesn't restrict the use of dozers, but because of other properties of portions of the FMU (e.g. steep, dissected terrain) the fire planner indicates that 50% of the ignitions in that FMU would not be able to use dozers for containment.
- In the Limited Access FMU, access to 50% of the land is restricted by bridges that have a 5 ton maximum rating. Knowing that only 10% of the ignitions in the FMU are in the portions that have this access restriction, the user creates and selects a restriction that applies to heavy equipment over 5 tons (e.g. all type 4 engines), and applies it to 10% of the ignitions in the FMU.

Data Source:

All inputs are user defined.

User Tasks:

The user must first create a set of restrictions to be used on one or more FMUs in the planning unit, and then they must select the appropriate restrictions for each FMU.

Step 1. Define Restrictions for the FPU:

Within the FPA software, the fire planner must to first define the restrictions that may be applied to one or more FMUs in the FPU.

- To create a restriction, the planner will use the software interface to
    - Provide a meaningful name for the restriction
    - Select one or more fire resources that will be restricted from responding when the restriction is applied to an FMU
    - Provide a concise, thorough rationale for the restriction.
- There is no limit on the number of restrictions that can be created for an FPU

Step 2. Select Restrictions for each FMU:

To apply a restriction to an FMU the planner will use the software interface to select an FMU and apply a previously defined restriction

- The user selects an FMU
    - Restrictions previously defined by the fire planner under the 'Create Restrictions' function will then be available to select for the FMU
    - The planner then enters the percent of ignitions in the FMU that the restriction will apply to, and 'Submits' the selections.
- Multiple restrictions may be selected for each FMU

System Implications:

The system will apply the restrictions to the designated percentage of ignitions in an FMUs fire scenario. Ignitions will be chosen on a random basis by the system.

For the selected ignitions, the restricted fire resources will be filtered and not used in the management of that ignition.

Special Notes on Restrictions:

Fire planners need to exercise caution in the definition and selection of restrictions!

- The use of multiple overlapping restrictions may result in fire resources being filtered at a greater rate than the user intends.
    - Example – The planner creates two restrictions for the FPU; one to restrict the use of dozers due to steep canyons, and another to restrict the use of dozers due to soft soils that could be damaged. For a particular FMU if both restrictions were selected and set to apply to 50% of the ignitions, dozers may be unintentionally restricted to up to 100% of all ignitions.

- Since the FPA-PM system has no spatial knowledge of where modeled fire events occur on the landscape, the restriction is designed to apply to a percent of ignitions instead of percent of area/acres of the FMU. Setting the proper percentage requires the fire planner have a good grasp of the local pattern of historic ignitions as well as a thorough knowledge of physical features affecting deployment of various fire resources to the ignitions in each FMU.

- Since this function can be used to 'skew' the results of an analysis, planners should use it sparingly, provide a sound rationale for its use, and be prepared to defend the restriction during an audit.